Indirect Measurement of Biological Activity to Monitor Natural Attenuation

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The remediation of ground water contamination by natural attenuation, specifically biodegradation, requires continual monitoring. This research is aimed at improving methods for evaluating the long-term performance of Monitored Natural Attenuation (MNA), specifically changes in the biogeochemical environment due to the biologically mediated breakdown of the contaminant. The research helps support the Superfund, RCRA, and the Oil Spills program research priorities and ground water research needs. Basic research is presented on the bulk ground electrical conductivity response to the biogeochemical dynamics occurring during the biologically mediated breakdown of non-aqueous phase liquids (NAPLs).

Investigations into the geoelectrical response that results from the biodegradation of NAPLs include a five-year field study, 45-day lab slurry experiment, and a two-year lab column study performed by a multidisciplinary group of scientists including several universities and the U.S. EPA. Metabolic byproducts of the microbial degradation of NAPLs react with the subsurface sediments and increase the geoelectrical conductivity of the contaminated zone undergoing biodegradation. The measurement of the geoelectrical conductivity is a very simple, inexpensive geophysical technique that can be applied and measured automatically and/or remotely.

EPA expects these findings to provide a new scientific understanding and scientific tool. The results from this work are expected to be used by OSWER, Regional Project Managers, Principle Responsible Parties, and project implementers to efficiently and effectively monitor and characterize natural attenuation in a cost-effective manner. This research has demonstrated a potential to improve monitoring for evaluating long-term performance of monitored natural attenuation. With this research providing the link between measurable physical changes and the biological breakdown of contaminants, the risks to human health and the environment that these contaminants pose can be more effectively controlled at contaminated sites. It is hoped that these findings will reduce analytical chemistry costs, reduce hazardous waste products from analysis, provide the capability to passively monitor the biodegradation process, and provide data for the development of a conceptual site model (CSM). Furthermore, this research presents a tool to safely return contaminated sites to appropriate uses more effectively, efficiently, and reliably than traditional methods.